The balance of power between producers and retailers : a differentiation model

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1 Introduction

The growing importance of mass distribution deeply transformed the balance of power between producers and retailers. In recent years, the number of products sold by grocery stores has grown faster than shelf space at the retail level. Retailers can choose among an ever increasing number of products. Producers compete in order to obtain the listing of their products, and in this process confer a stronger bargaining power to retailers, who can threaten to outlist their products to obtain more profitable retail conditions.

Hence the balance of power between producers and retailers no longer systematically advantages manufacturers. Retailers' bargaining power has increased, and sometimes they even have taken control of producers which have become subcontractors[1]. Recent mergers between large retailers emphasize this evolution. These changes have consequences on vertical relationships, and significant implications on competition policy. The increase in retailers' buying power may indeed have several effects on welfare. By lowering wholesale prices, retailers' power may lower retail prices and enhance consumers' surplus. But an imbalance between suppliers and retailers may also have detrimental effects on consumers' surplus and on welfare[2],

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[1] See Mills (1995).

[2] For an analysis of the distorsions in competition induced by buyer power, see Dobson Consulting (1999).

distorting both retail and producer competition, reducing producers' incentives to innovate, and even eliminating some producers from the market. Il might then be worth taking into account and measuring this balance of power in vertical structures.

Yet the economic theory of vertical relationships has traditionally given a dominant position to producers in their relationship to retailers. In particular, the literature on vertical restraints[3] usually analyses the impact of a contracting condition imposed by one producer on several retailers in a Principal-Agent model. Even though some models happen to consider several competitive producers[4], most of them assume that retailers are perfectly competitive : this assumption seems rather unrealistic and prevents from taking their relative bargaining powers into account.

Contrary to the classical literature on this subject, Shaffer (1991) proposed a model presenting a market for a homogeneous good produced by perfectly competitive manufacturers and sold by a differentiated retail duopoly. The usual balance of power is reversed : retailers can appropriate the whole profit of the vertical structure by requiring slotting allowances, that is fixed fees paid by manufacturers to obtain listing guarantees. Slotting allowances can be interpreted as negative franchise fees.

The strength of competition at each level of the vertical structure thus seems to be a basic determinant of the balance of power between producers and retailers. A monopolistic producer facing a competitive distribution network can impose his conditions, whereas a perfectly competitive manufacturing sector facing a retail oligopoly, as in Shaffer (1991), has a reduced room for manoeuvre. A double duopoly model (upstream and downstream) seems adequate to integrate imperfect competition at both levels of the vertical structure. In such a setting in which both products and retailers are differentiated, Dobson and Waterson (1996) consider the private and social desirability of exclusive trading contracts between producers and retailers. In this paper, we focus on the sharing of profits between the firms, without vertical restraints, to study the balance of power between upstream and downstream firms.

As far as the balance of power between producers and retailers is concerned, a good indicator can be obtained in comparing their relative margins. Hence Steiner (1985) proposed a simple rule to determine their relative market powers, depending on consumers' preferences for brand or store :

> "A good rule of thumb to determine the relative market power of retailers and manufacturers goes as follows. If consumers are more disposed to switch brands within store than stores within brand, retailers dominate manufacturers. Retail margins will be relatively high and those of manufacturers relatively low. When consumers are more disposed to switch stores within brand than brands within store, the above market power and margin relationships are reversed".

[3] For a general presentation of the subject, see Katz (1989).

[4] See for example Rey and Stiglitz (1995).

These consumers' preferences can be interpreted in terms of horizontal differentiation and their impact on pricing decisions can be evaluated.

This paper proposes a double duopoly model, in which two producers compete in prices with horizontally differentiated products, and face two horizontally differentiated retailers also competing in prices[5]. We study the setting of the margins at the two levels of the market. The parameter defined as the difference between the two degrees of differentiation is a good indicator of consumers' preference for the brand or the store : when retailers are more differentiated than producers, consumers actually switch brands more readily than stores, because switching costs are lower. Assuming that the value of this parameter is common knowledge, we can thus study its impact on the fixing of wholesale and retail prices, and on the margins.

In this simple setting, we show that when producers are more differentiated than retailers, their margins are higher than retailers'. On the other hand, when retailers are more differentiated than producers, they dominate the relationship and their margin is higher than producers'. The difference of the degrees of differentiation has a significant impact on the balance of power between producers and retailers.

We present the model in section 2. The symmetric equilibrium prices and profits with linear pricing are determined in section 3. We conclude in section 4.

2 The model

2.1 Hypotheses

Consider two manufacturers A and B producing two horizontally differentiated goods with the same constant marginal cost c. Two retailers, 1 and 2, are horizontally differentiated and each of them sells both goods. Without loss of generality, the marginal retailing costs are set equal to zero. We assume that producers are unable to set up shop and sell independently. Thus, four differentiated goods are available for consumers to purchase : firm A's product at store 1, which is called A1, firm A's product at store 2, called A2, and similarly B1 and B2.

Consumers are uniformly distributed on the rectangle[6] (see Figure 1) where product A1 is located at the origin, A2 at the point of coordinates $(\alpha, 0)$, product B1 at the point of coordinates $(0, \beta)$ and product B2 at the point of coordinates (α, β). This representation allows us to point out two

[5] It could refer for example to spatial differentiation.

[6] The location of the firms is exogenous. β is fixed. The comparison of different values of α might refer, for instance, to the comparison of different linear cities with the same total population, where the stores, located at the two ends of each city, are distant from α and sell both goods.

types of differentiation : the rectangle's width β ($\beta \in [0, +\infty[$) represents the producers' differentiation on the vertical axis while its length α ($\alpha \in [0, +\infty[$) represents the retailers' differentiation on the horizontal axis. Let t be the difference $\alpha - \beta$. When $t \leqslant 0$, retailers are less differentiated than producers, and consumers "are more disposed to switch stores within brands than brands within stores". On the contrary, when $t \geqslant 0$, retailers are more differentiated than producers.

To keep the population constant whatever the values of parameters α and β, the consumers' density is set equal to $1/\beta$ vertically and $1/\alpha$ horizontally. The global population is thus normalized to 1. As a matter of convenience, we assume that each consumer located on the rectangle purchases zero or one unit of his preferred good. Figure 1 shows the situation of a consumer M whose coordinates in the products space are (x, y) :

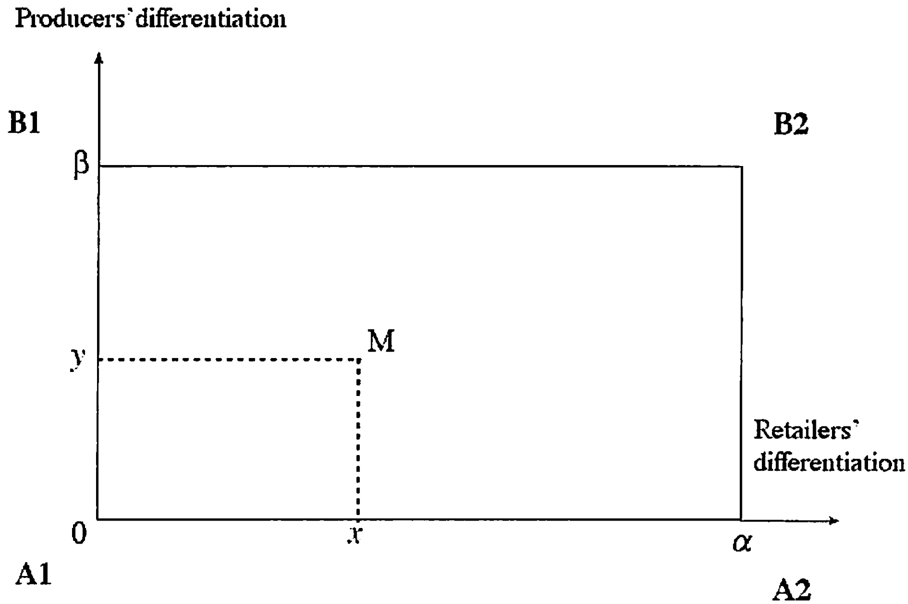

Figure 1

This representation of consumers preferences is an extension of Hotelling's model with two dimensions[7]. The coordinates of a consumer in the products space may be interpreted in terms of double horizontal differentiation. A consumer located at a point of coordinates (x, y) has a preferred store that would be x away from store 1 and $(\alpha - x)$ away from store 2; similarly he has a preferred product that would be y away from product A and $(\beta - y)$ away from product B. His preferred variety would therefore

[7] For a similar representation of double differentiation, see Matutes and Regibeau (1988). Other double differentiation models, as Dobson and Waterson (1996), impose an affine demand which allows to take double marginalisation effects into account. On the contrary, our extension of Hotelling's model allows to endogenise demand, but its study requires to assume that the market is covered.

be $(x+y)$ away from product A1. Notice that the two dimensions of differentiation are fully separable[8]. Consumers have simple utility functions, which depend on their reservation price, their coordinates in the products space and the price of the good they purchase. We assume that consumers differ only by their location in the rectangle and that they all have the same reservation price d.

A consumer located at point (x, y) has a utility of:

– If he buys one unit of good A1 : $U(A1) = d - (x+y) - p_{A1}$

– If he buys one unit of good B1 : $U(B1) = d - (x+\beta-y) - p_{B1}$

– If he buys one unit of good A2 : $U(A2) = d - (\alpha - x + y) - p_{A2}$

– If he buys one unit of good B2 : $U(B2) = d - (\alpha - x + \beta - y) - p_{B2}$

where $p_{Ik}$is the price of good I at store k. $(I \in \{A, B\}; k \in \{1, 2\})$

We assume that the whole market is served, *i.e.* that the reservation price d is "sufficiently high". Hence we can define the equations of *indifference borders* between two goods, consumers located on this border being indifferent between the two goods, and those located on one side of the border or the other preferring one good or the other. Then the consumers' *indifference borders* are:

– between A1 and A2 : $x_A = \dfrac{\alpha + p_{A2} - p_{A1}}{2}$

– between B1 and B2 : $x_B = \dfrac{\alpha + p_{B2} - p_{B1}}{2}$

– between A1 and B1 : $y_1 = \dfrac{\beta + p_{B1} - p_{A1}}{2}$

– between A2 and B2 : $y_2 = \dfrac{\beta + p_{B2} - p_{A2}}{2}$

– between A1 and B2 : $x + y = \dfrac{\beta + \alpha + p_{B2} - p_{A1}}{2}$

– between A2 and B1 : $y - x = \dfrac{\beta - \alpha + p_{B1} - p_{A2}}{2}$

This means that a consumer located at point (x, y) will prefer to purchase good A at store 1 rather than at store 2 if $x \leqslant x_A$. Similarly, if $y \geqslant y_1$, he will prefer to buy good B rather than good A at store 1[9].

2.2 Determination of the demand functions

8 This assumption seems realistic, as it seems intuitive that retailers' differentiation relies mostly on geographic differentiation, whereas brands' differentiation relies on consumers' heterogeneous tastes.

9 Notice a few obvious properties of these borders: $|y_2 - y_1| = |x_B - x_A|$, and indifference border between A1 and B2 (respectively between A2 and B1) contains the points $y_1 \cap x_B$ and $y_2 \cap x_A$ (respectively $y_1 \cap x_A$ and $y_2 \cap x_B$).

We suppose that retailers choose retail prices so that *indifference borders* intersect inside the rectangle (this is sufficient to obtain zero demand for one good):

$$(x_A, x_B) \in [0, \alpha]^2$$
$$(y_1, y_2) \in [0, \beta]^2$$

Moreover, we need to assume that $x_A \geqslant x_B$ ($\Leftrightarrow y_1 \geqslant y_2$) in order to write the demand functions. We will check afterwards that the equilibrium follows these assumptions. The symmetric case can be treated in the same way.

The demand for good Ik ($I \in \{A, B\}; k \in \{1, 2\}$) is represented by the area in which consumers prefer to purchase good Ik rather than any other one. Therefore we have:

$$D_{A1} = \frac{\max\{0, \beta + p_{B1} - p_{A1}\} * \max\{0, \alpha + p_{A2} - p_{A1}\}}{4\alpha\beta} - \frac{(\max\{0, p_{A2} - p_{A1} + p_{B1} - p_{B2}\})^2}{8\alpha\beta}$$

$$D_{A2} = \frac{\max\{0, \alpha - p_{A2} + p_{A1}\} * \max\{0, \beta + p_{B2} - p_{A2}\}}{4\alpha\beta}$$

$$D_{B1} = \frac{\max\{0, \beta - p_{B1} + p_{A1}\} * \max\{0, \alpha + p_{B2} - p_{B1}\}}{4\alpha\beta}$$

$$D_{B2} = \frac{\max\{0, \alpha - p_{B2} + p_{B1}\} * \max\{0, \beta + p_{A2} - p_{B2}\}}{4\alpha\beta} - \frac{(\max\{0, p_{A2} - p_{A1} + p_{B1} - p_{B2}\})^2}{8\alpha\beta}$$

Notice that demand functions are not symmetric if *indifference borders* do not coincide: the demand for each good varies with the four prices. Figure 2 represents the distribution of demand between the four goods.

A sufficient condition for the market to be covered is that $\forall (I, k), I \in \{A, B\}$, $k \in \{1, 2\}$, $p_{Ik} \leqslant \overline{p}$ where $\overline{p} = d - \frac{\alpha+\beta}{2}$: then each consumer can purchase at least one good with a positive surplus. In that case, total demand for the four goods is constant :

$$D_{A1} + D_{B1} + D_{A2} + D_{B2} = 1$$

Notice that we focus here on the distribution of the demand between the four goods, and do not pay attention to the variations of total demand: we consider that the market is "locally captive".

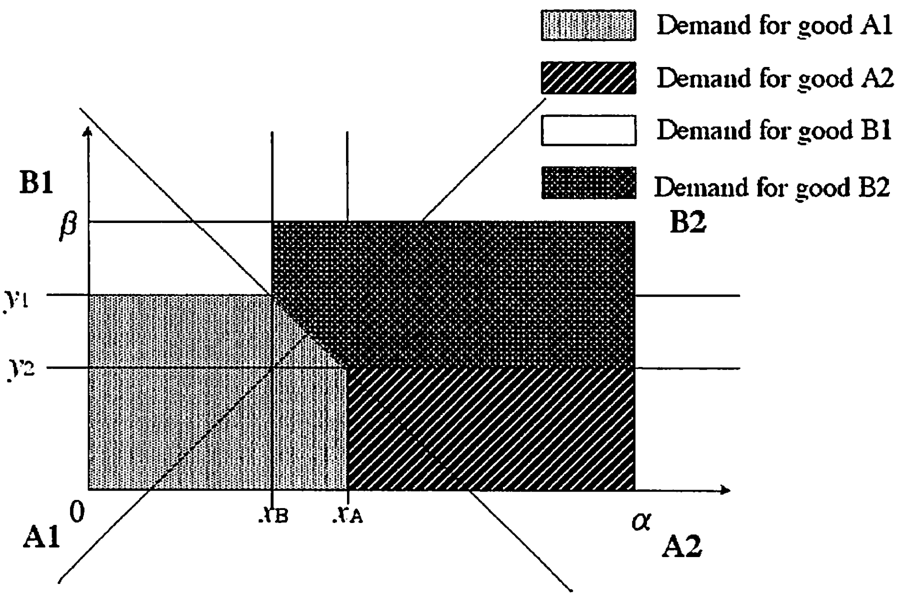

Figure 2

2.3 The game

In this model we use the usual principal-agent structure, which enables producers to make take-it-or-leave-it offers to retailers. We solve the following three-stage game for its symmetric subgame-perfect Nash equilibria.

In the first stage, both manufacturers simultaneously propose contracts to the retailers. Each contract consists of a single wholesale price (w_A or w_B), franchise fees and slotting allowances are not allowed. Manufacturers cannot price-discriminate[10] between retailers. We assume that contracts are published at the end of the first stage, and that no renegotiation is possible[11].

In the second stage, retailers accept or refuse to list manufacturers' products. If they both accept to list at least one of the producers, they behave as Bertrand competitors with differentiated products : they simultaneously set their retail prices p_{A1}, p_{A2}, p_{B1}, p_{B2}, and publish them. If a retailer rejects both contracts, his reservation profit is 0.

In the third stage, consumers purchase one unit of their preferred good provided that it leaves them with a positive surplus.

We solve the game by backward induction.

[10] This assumption is legally founded, as price discrimination in a homogenous good market with linear pricing is forbidden in most countries. Moreover, it is consistent with the fact that we focus on symmetric situations.

[11] Introducing secret contracting in this game would considerably modify its solutions and give rise to renegotiation-proofness problems. See O'Brien-Shaffer (1992).

3 Equilibrium prices and profits

In the third stage, consumers buy one unit of their preferred good knowing retail and wholesale prices (recall that we assumed that their reservation price is sufficiently high to allow the whole market to be covered).

In the second stage, each retailer sets profit-maximizing retail prices, taking wholesale prices w_A and w_B and parameters α and β as given:

$$\max_{p_{Ak}, p_{Bk}} \Pi_k = (p_{Ak} - w_A)D_{Ak} + (p_{Bk} - w_B)D_{Bk}$$
$$k \in \{1, 2\}$$

Solving those profit maximizing problems at the retail stage gives the best response functions of the two retailers and determines the system of equilibrium retail prices $\{p_{A1}, p_{A2}, p_{B1}, p_{B2}\}$ as a function of $\{w_A, w_B, \alpha, \beta\}$.

In the first stage, each producer, anticipating retailers' reaction functions, maximizes the profit of the sale of his product to the two retailers:

$$\max_{wI} \Pi_I = (w_I - c)(D_{I1} + D_{I2})$$
$$I \in \{A, B\}$$

The resolution of the system of the first-order conditions is not easy, because each first-order condition is of the second degree and depends on the four retail prices and the two wholesale prices. However, the symmetric equilibrium appears to have a remarkably simple form.

Proposition 1 *The unique symmetric subgame-perfect Nash equilibrium of this game is as follows:*

$$p^*_{A1} = p^*_{A2} = p^*_{B1} = p^*_{B2} = c + \alpha + \beta$$
$$w_A = w_B = c + \beta$$

Proof: see appendix 1. □

This is an equilibrium as long as the market is covered, *i.e.* as long as $d \geqslant c + \frac{3(\alpha+\beta)}{2}$. The assumptions made earlier are satisfied: each good faces a strictly positive demand (in fact, $D_{A1} = D_{B1} = D_{A2} = D_{B2} = 1/4$) and $x_A \geqslant x_B$.

The corresponding profits are:

$$\Pi_A = \Pi_B = \frac{\beta}{2}$$

$$\Pi_1 = \Pi_2 = \frac{\alpha}{2}$$

Wholesale prices correspond to the prices both producers would set if they were to impose retail prices. If producer A could impose retail price p_A and similarly B could impose retail price p_B, they would maximize their profits by setting retail prices equal to:

$$p_A = p_B = c + \beta$$

In this model however, retail price maintenance is not allowed, so that producers cannot influence retailers in their choice of retail prices. However, since total demand is locally constant as we focus on cases where the market is covered, the ensuing double marginalization problem does not reduce the producers' profit: in spite of the foreseeable rise of retail prices as α increases, producers do not modify wholesale prices; their profit neither depends on α nor on retail prices. Their margin is exactly β.

Parameter α only influences retailers in the choice of their retail prices. α exactly corresponds to the retail margin: when retailers are not differentiated ($\alpha = 0$), they are perfectly competitive and charge a zero retail margin. On the other hand, when α is relatively high in comparison with β, retailers are more differentiated than producers and face less competition: their margin is larger.

The difference between producers' and retailers' margins is equal to $t = \alpha - \beta$. This parameter also seems to be a relevant indicator of the balance of power between producers and retailers: when $t \leqslant 0$, retailers are "dominated" by manufacturers, in the sense of Steiner, insofar as their margins are lower than the producers'. On the contrary, when $t \geqslant 0$, the retailers' margins grow larger than the producers', who now are dominated in the vertical relationship.

However, this domination concept, relying on the comparison of margins, should be cautiously interpreted in relative terms. The additive form of the margins in equilibrium depends on the assumption of fully separable differentiation. Assuming locally constant demand, the entire weight of the double marginalization is actually shifted onto consumers, and the margin at one level of the market is not established at the expense of the margin at the other level of the market. But, using the share of total profit among the vertical structure as a proxy for the balance of power between the firms, our model confirms Steiner's intuition and shows that the difference of the differentiations between upstream and downstream firms influences the balance of power between the firms.

4 Conclusion

This article proposes an interpretation of the balance of power between producers and retailers in terms of differentiation. In a market for two differentiated goods with a "locally captive" demand, we show that the difference between the margins charged by producers and retailers depends on the difference of the differentiations between upstream and downstream firms, which in fact indicates the relative degrees of competition at each level of the market.

However, these results have been obtained in a simple setting, and in particular they are limited to the symmetric case. An interesting extension would be to introduce exclusive dealing contracts, which might allow foreclosure or outlisting strategies. Such contracts might then change the balance of power between upstream and downstream firms. The study of exclusivity would require the determination of the asymmetric equilibria of the game and is left for future work.

5 Appendix

Sketch of Proof of Proposition 1

To determine the symmetric equilibria of the game, we might first calculate retailers' reaction functions, then reintroduce them in the producers' profit maximizing problem, and finally choose among the solutions the symmetric ones. But the four first-order conditions given by the retailers' profit maximization problem are of the second degree, and depend on four variables. The analytical resolution of this system is not possible in the general case. It is easier to solve all the equations simultaneously, with the conditions of symmetry on wholesale and retail prices, and using the implicit functions theorem.

In the second stage, retailers determine retail prices as a function of wholesale prices, which induces four first-order conditions. We define the following notation : $P = (p_{A1}, p_{B1}, p_{A2}, p_{B2})$ and $W = (w_A, w_B)$..The system of the four first-order conditions gives P as an implicit function of $W : P = D(W)$.

In the first stage, producers anticipate these conditions and maximize their profits. The first order conditions determine the following system :

$$\frac{\partial \Pi_A}{\partial w_A} + \frac{\partial \Pi_A}{\partial D}\frac{\partial D}{\partial w_A} = 0$$

$$\frac{\partial \Pi_B}{\partial w_B} + \frac{\partial \Pi_B}{\partial D}\frac{\partial D}{\partial w_B} = 0$$

Let M be the Hessian matrix of retailers profit function. M is generically invertible.

Let $N = M^{-1}$, and $V_A = \left(\frac{-\partial^2 \Pi_1}{\partial w_A \partial p_{A1}}, \frac{-\partial^2 \Pi_1}{\partial w_A \partial p_{B1}}, \frac{-\partial^2 \Pi_2}{\partial w_A \partial p_{A2}}, \frac{-\partial^2 \Pi_2}{\partial w_A \partial p_{B2}}\right)$.

We have $\frac{\partial D}{\partial w_A} = N.V_A$. It is not simple to write N in the general case. But in order to look for symmetric Nash equilibria, we have the following symmetry conditions: $w_A = w_B = w$, $p_{A1} = p_{A2}$ and $p_{B1} = p_{B2}$. We can show that any symmetric equilibrium verifies $p_{A1} = p_{A2} = p_{B1} = p_{B2} = p$, but the proof is tedious and is omitted here. In that case, the matrix M becomes:

$$M = \begin{bmatrix} \frac{-2\alpha-2\beta+p-w}{4\alpha\beta} & \frac{2\alpha-p+w}{4\alpha\beta} & \frac{\beta}{4\alpha\beta} & 0 \\ \frac{2\alpha-p+w}{4\alpha\beta} & \frac{-2\alpha-2\beta+p-w}{4\alpha\beta} & 0 & \frac{\beta}{4\alpha\beta} \\ \frac{\beta}{4\alpha\beta} & 0 & \frac{-2\alpha-2\beta+p-w}{4\alpha\beta} & \frac{2\alpha-p+w}{4\alpha\beta} \\ 0 & \frac{\beta}{4\alpha\beta} & \frac{2\alpha-p+w}{4\alpha\beta} & \frac{-2\alpha-2\beta+p-w}{4\alpha\beta} \end{bmatrix}$$

We can now solve the four first-order conditions and the symmetry conditions simultaneously, and the unique solution is as follows:

$$p = p_{A1} = p_{B1} = p_{A2} = p_{B2} = c + \alpha + \beta$$
$$w = w_A = w_B = c + \beta$$

We now have to check that this unique candidate is indeed an equilibrium, and that there is no possible profitable deviation, even asymmetric. Let $w_B = c + \beta$. Fixing w_A outside of the interval $[c, w_B + \beta]$ would leave producer A with a negative profit. We verify that, whatever w_A in this interval, the retailers' best response functions intersect at the point defined by $(p^*_{A1} = p^*_{A2} = w_A + \alpha, p^*_{B1} = p^*_{B2} = w_B + \alpha)$ which thus defines a Nash equilibrium of the subgame. It is then straightforward to verify that $w_A = c + \beta$ maximizes producer A's profit at the first stage.

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